

CLAIMS

1. A product including one or more component sections of thermoplastic polymer with incorporated anti-microbial additive with efficient sizing, placement and quantity therein and at least one other component acting to afford a primary characteristic of one or more of strength, color, fire retardance, odor suppression or modification, hydrophilic or hydrophobic characteristic promoting or suppressing, texture controlling and ultraviolet resistance to the product, the product as a whole being constructed and arranged to suppress substantially microbial growth and the like (e.g., fungal, mildew or mold activity) therein and/or to impart such suppression action to an environment in which the product is ultimately used.
- 2.. The product of claim 1, wherein the product is of coherent form and has a distinct end product usage.
3. The product of claim 1, wherein the section with additive is fibrous.
4. The product of claim 1, wherein the product comprises at least one indefinite form selected from the group consisting of yarn, tow, flat sheet, shaped sheet (e.g. complex extrusion), film, monofilament, fabric, fabric laminate, film, film laminate, sheet, and fabric/film laminate.
5. The product claim 1, wherein the product comprises a fabric section selected from the forms consisting of woven, knit, spun, non-woven (including fleece, air laid, flocked, needle punched, spunbonded, spunlaced and thermobonded forms.
6. The product of claim 4, wherein the section with additive is fibrous.
7. The product of claim 6, wherein the fibrous section comprises a multi-component

fiber, the components extending along all or a substantial length portion thereof, with the anti-microbial additive in less than all components thereof, presented as (a) a multi-component fiber as formed or (b) a blend of fibers with different melting points so that the one holding the additive melts below the melting point of and wets one or more other components or (c) a combination of the (a) and (b) conditions.

8. The product of claim 7, wherein the components are in a core/sheath configuration and the anti-microbial additive is in the sheath.
9. The product of claim 8, wherein the sheath is sized to hold the additive close to the outer fiber surface while affording strong resistance to removal thereof under production and usage conditions of fiber and fabric.
10. The product of claim 1, wherein the additive is one selected from the group consisting of copper, zinc, tin and silver.
11. The product of claim 10, wherein the additive is a zeolite of silver or other carrier including zirconium phosphate or dissolvable glass.
12. The product of claim 1, wherein the one or more component sections comprise multiple components in a core/sheath fiber configuration and the sheath is more than 30% of the cross section of the total cross section of the fiber.
13. The product of claim 1, wherein the antimicrobial additive comprises approximately 1 micron cubic particles and the thermoplastic component section containing the additives is approximately 2 microns thick and surface accessible or a similar ratio wherein the thermoplastic section thickness is slightly greater than the longest dimension of the additive in particle form.

14. The product of claim 13, wherein the additives are 0.01 to 6.0% by weight of the product.
15. The product of claim 1, wherein the antimicrobial additive is a zeolite of silver dispersed in the thermoplastic polymer I selected from the group of polyolefin, PET, PETG, PCT, PCL, PBT, polyamides, 3GT, PTT, styrene, polyamide (nylon 6 or 6.6), or acrylic polymers.
16. The product of claim 1, wherein the antimicrobial additive is in one or more fibers blended with one or more other fibers selected from the group consisting of cotton, wool, polyester, acrylic, polypropylene, rayon, acetate, and nylon, the one or more other fibers being free of anti-microbial agents internally and except as imparted thereto by the one or more additive-containing fibers.
17. The product of claim 16, wherein the fibers are comprised of mono-components.
18. The product of claim 16, wherein the fibers are comprised of multi-components.
19. The product of claim 14, wherein the polymers are of at least one chosen from the group consisting of PE, PP, PET (polyester), PCT, PETG, Co-PET, Styrene, PTFE (Halar®), PTT, 3GT, and polyamide 6 or 6,6.
20. The product of claim 1, wherein the product is in the form of one or more fibers from 0.7 dTex to 25.0 dTex in size.
21. The product of claim 20, wherein the fiber is cut staple in lengths from 1.0 mm to 180.0 mm.
22. The product of claim 1, wherein the product is in the form of one or more fibers

having one or more components in continuous filament form.

23. The product of claim 1, wherein the product is in the form of one or more fibers, each configured with:
 - a core of a high tenacity polymer having at least 10% and less than 70% of the fiber by cross sectional area,
 - a sheath of a hydrolysis resistant polymer having over 30% of the core/sheath combined cross sectional area, and including an additive, and
 - wherein the additive in the sheath comprises from 0.01 % to 20 % by weight of the fiber and is selected from the group consisting of anti-microbials and optionally additional additives selected from the group consisting of pigments compounds creating a hydrophilic surface, UV stabilizers, and fire retardants.
24. The product of claim 23, wherein each core may be comprised of high tenacity PET, and each sheath may be comprised of PCT providing a hydrolysis resistant surface with good wrinkle resistance, and resistance to long term washings, in boiling water and strong soaps.
25. The product of claim 24, with the core of each fiber constructed to have a high modulus with properties of tenacity and elongation similar to cotton.
26. The product of claim 24, with the core of each fiber constructed to have properties similar to wool.
27. The product of claim 24, with the cores of said fibers constructed to have an intermediate modulus fiber with properties between cotton and wool.
28. The product of claim 23, wherein the additional additive is hydrophilic such that the one or more fibers, in a garment or the like, can wick body moisture away from the

skin and evaporate to create comfort to a wearer.

29. The product of claim 23, wherein the additional additive is pigment that provides uniform colors that do not fade significantly over long-term use and washing.
30. The product of claim 1 as a fiber blend, comprising:
 - a binder fiber made from low temperature polymer with a melting or softening temperature below 200 degrees C.;
 - an anti-microbial additive of an inorganic compound made from a metal chosen from the group consisting of copper, zinc, tin and silver added to the binder fiber, the additive ranging from 0.1 to 20% by weight of the fiber; and
 - fibers which are free of anti-microbial additive being blended with the binder fiber, the blend of fibers having been heated to its melting temperature, thereby providing a fiber blend which can be used to produce an anti-microbial finished fabric able to withstand significant wear and washings and maintain its effectiveness.
31. The product of claim 30, wherein the binder fiber composition is selected from the group consisting of PETG, PE, PP, Co-PET, polycaprolatone and amorphous PET.
32. The product of claim 31, wherein the anti-microbial additive is a zeolite of silver (or other carrier including zirconium phosphate and dissolvable glass) dispersed in PE, PET or PBT (or similar carriers) before being added to the polymer matrix of the fiber.
33. The product of claim 30, wherein the non-anti-microbial fiber is selected from the group consisting of cotton, wool, polypropylene, polyester, acrylic and nylon.
34. The product of claim 30, wherein the binder fiber comprises PETG polymer, said anti-microbial additive comprises zeolite of silver, and said non-anti-microbial fiber

comprises cotton.

35. The product of claim 34, wherein the PETG polymer with the zeolite of silver additive is blended with the cotton up to 10% by weight to produce a fiber particularly suitable for a bed sheet.
36. The product of claim 30, wherein the binder fiber is activated in a drying cycle of a bleaching operation (or other fabric finishing operation) to melt and wet the surface of the cotton fibers to carry the anti-microbial characteristics to the entire bed sheet with an added benefit of increasing strength and reducing pilling.
37. The product of claim 30, wherein the fiber size ranges from 0.7 dTex to 25.0 dTex, and the fiber is cut staple in lengths from 1.0 mm to 180.0 mm.
38. The product of claim 30, wherein the fiber is a continuous filament in a wrap spun application and said non-anti-microbial fiber is spun around an anti-microbial filament.
39. The product of claim 1, forming at least a part of a multi-layer incontinent article.
40. The product of claim 39, forming a garment.
41. The product of claim 39, forming a linen.
42. The product of claim 39, forming a bed pad.
43. The product of claim 39, wherein the article is prepared of woven fabric, non-woven fabric, or knitted fabric.

44. The product of claim 39, formed as a diaper.
45. The product of claim 39, formed as an absorbent pad.
46. The product of claim 39, including a wick layer and an adsorbent layer.
47. The product of claim 46, wherein the layer which is intended to be against a wearer's skin is made of anti-microbial fibers.
48. The product of claim 39, formed as underwear.
49. The product of claim 39, formed as pajamas.
50. The product of claim 1, forming at least part of a single layer or multi-layer filter.
51. The product of claim 50, wherein the filter is a liquid filter.
52. The product of claim 50, wherein the filter is a gas or air (HVAC) filter.
53. The product of claim 50, further comprising an anti-odor agent added to the filter.
54. The product of claim 50, wherein the anti-microbial additive is disposed in a layer on the intended upstream side of the other layers.
55. The product of claim 1, formed as part of a multi-layer wound care or burn dressing.
56. The product of claim 55, wherein at least one layer has the anti-microbial fiber, said layer being on the intended skin side of the other layers.

- 57. The product of claim 56, wherein at least one other layer is of an adsorbent material.
- 58. The product of claim 30, forming at least part of a fabric wherein PETG is used as the carrier for color pigments for said fabric.
- 59. The product of claim 58, wherein the PETG has been melted as a low temperature and has had an anti-microbial and/or a colorant added thereto prior to melting
- 60. The product of claim 1, forming at least part of a multi-layer footwear component.
- 61. The product of claim 60, formed as at least one component selected from an insole, midsole, box toe, counter, and lining.
- 62. The product of claim 1, forming at least part of a multi-layer laminate of high porosity between two internal layers thereof, one of which is bonded to the other with lateral fibers traversing parts of both layers, one or both of such layers incorporating anti-microbial agents, and means for acquiring moisture vapor into the laminate and trapping it there, one of the internal layers having higher strength properties than the other and the other having a higher moisture retention capacity.
- 63. The product of claim 62, further comprising an insertable/removable insole for a shoe or the like.
- 64. The product of claim 1, forming at least part of a multi-layer partition or as a fabric for office, hospital, waiting area, classrooms, busses, cars, and the like and also curtains, upholstery, carpets and bedspreads.
- 65. The product of claim 1, forming at least part of a car wash material.

- 66. The product of claim 1, forming at least part of a filter or a batt in a car wash water recycle storage tank.
- 67. The product of claim 66, wherein the filter or batt is formed substantially straight to avoid clogging.
- 68. The product of claim 1, forming at least in part institutional and home furnishings, including bed sheets, pillow cases, mattress pads, blankets, towels, drapes, bedspreads, pillow shams, carpets, walk-off mats, napkins, linens, wall coverings, upholstered furniture, liners, mattress ticking, mattress filling, pillow filling, carpet pads, and upholstery fabric.
- 69. The product of claim 1, forming at least in part athletic clothing, athletic wear liners and component fabrics.
- 70. The product of claim 1, forming at least in part a mop head fabric.
- 71. The product of claim 1, forming at least in part a medical wipe.
- 72. The product of claim 1, forming at least in part a dust mask.
- 73. The product of claim 1, forming at least in part a humidifier evaporation surface media and/or a circulation/ aeration system pad.
- 74. The product of claim 1, forming at least in part a boat bilge anti-microbial pad.
- 75. The product of claim 1, forming at least in part a laundry bag.

- 76. The product of claim 1, forming at least in part a piece of apparel.
- 77. The product of claim 1, forming at least in part a nautical, awning, or umbrella fabric.
- 78. The product of claim 1, forming at least in part a layer of a wide stiff plastic sheet